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MATRIX DATA ANALYSIS: COLOR/B&W CODING IS NOT ALWAYS ENOUGH.(U)
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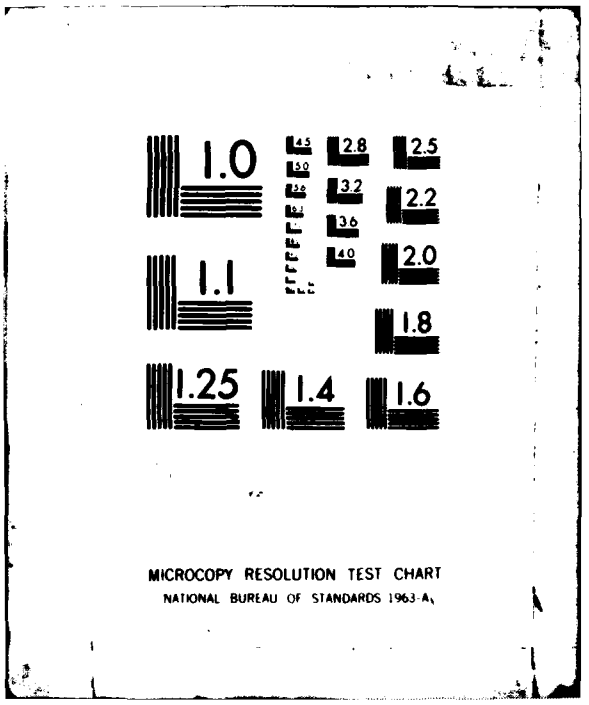
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The Defense Mapping Agency produces digital cartographic data bases that describe the physical appearance of the surface of the earth. Specialized processing and display techniques such as convolution filtering, texture discrimination, and specialized color/B&W displays allow for sophisticated analyses that are applicable to all types of matrix data.

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MATRIX DATA ANALYSIS:

COLOR/B&W CODING IS NOT ALWAYS ENOUGH

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ABSTRACT

The Defense Mapping Agency produces digital cartographic data bases that describe the physical appearance of the surface of the earth. Specialized processing and display techniques such as convolution filtering, texture discrimination, and specialized color/B&W displays allow for sophisticated analyses that are applicable to all types of matrix data.

MATRIX DATA ANALYSIS

COLOR/B&W CODING IS NOT ALWAYS ENOUGH

Background

The Defense Mapping Agency produces digital data bases that describe the physical appearance of the surface of the earth. These data bases include, but are not limited to, terrain elevation, culture including landscape characteristics, and vertical features. This data is collected from digitized source maps, from optically or digitally correlated stereo-pairs of photographic imagery, and from digital multi-spectral sensor data. A dramatic impact has been made in the ability to analyze these digital data bases by applying state-of-the-art digital image technology processing and display concepts. These include a variety of color and/or black and white displays of not only intensity/color coded matrix data, but also image processed data using specialized convolution filters, texture discrimination, and special color representation techniques. In addition, computer generated imagery from these data bases serve as a final analysis tool.

Techniques and Results

With results similar to those from manually compiled classical mapping and charting displays, digital terrain elevation data may be used to generate a standard contour plot and the corresponding tint plate in which the areas between contour lines are either color or gray level coded. An alternative is to color or gray level code the matrix terrain data directly. While analysis of these matrix image displays is superior to trying to perform analysis by visual inspection of the data in printed numerical matrix format, they only provide for a low spatial resolution analysis capability. Shaded relief display with variable

illumination adds additional information for analysis of all types of matrix data, but is particularly meaningful for cartographic data because of the relationship to the physical world. Higher spatial resolution analysis of the shaded relief display may be gained by applying photogrammetric models to generate pseudo-stereo-pairs of images in which spike points are apparent under stereoscopic analysis. These techniques, used singly or in combination, allow for matrix data analysis far superior to techniques of a decade ago, but they are not enough.

In order to perform high resolution anomaly analysis of matrix data for the purpose of either quality control or information gathering, advanced techniques are required. These techniques include convolution filtering, texture discrimination, and specialized color representation.

Convolution filters have been used very effectively to enhance matrix data to show processing anomalies as well as where data has been merged from different production equipment, different stereo models, different production methods, variable requirement specifications, and even from different analysts. These types of filters are used extensively by the image processing community to detect edge differences, and then to re-apply the differences to sharpen the original image. They also have been shown to be a powerful tool for the analysis of matrix data.

Texture analysis has proven to be very powerful for discriminating small area data that has been merged into larger matrices. For example, digital elevation data produced at a one arc second interval was sampled and merged with three arc second data. Because of inherent higher frequency information in the one arc second data, there is a noticeable difference between the textures of the levels of data in shaded relief displays. A similar difference is noticed with digital culture data.

For the purpose of determining compatability between data types, such as between digital terrain and culture data, simple color coding and overlay in Red-Blue-Green (RBG) space may not be sufficient. A more powerful technique employs coding each data type along an Intensity-Hue-Saturation (IHS) axis and then converting from IHS space to RBG space prior to display. Since the visual perception process can distinguish variation between IHS, the data types can be overlayed without a merging of colors, and therefore, without an information loss.

Finally, and probably unique to map type data, is the technique of computer generating landform scenes as seen by various visual and electro-optical sensors. This allows for a final quality control analysis of information content, and also has been very valuable in the definition of data base requirement specification.

Impact

The impact of these digital image technology concepts to matrix data display and analysis have been enormous. Not only has there been a greatly increased capability for the degree and sophistication of quality control, but there is an associated cost savings in both the quality control review process, and in the resultant expense of using matrix data containing anomalies. These techniques have application to all types of matrix data production as well as for the analysis of all types of real matrix data.

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Author's Note: Most the examples to be shown in the presentation are new and not covered by the above references.

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